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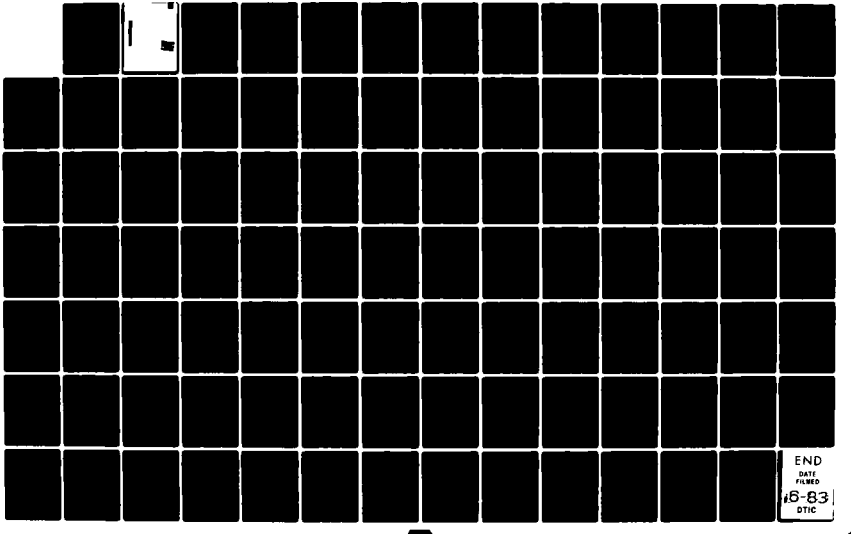

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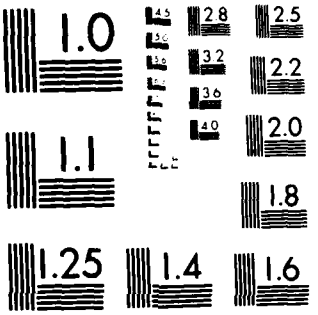

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. A128 067	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Comparison of Weight Training and Calisthenic Exercise Programs in Developing Strength and Muscular Endurance in United States Army Recruits		5. TYPE OF REPORT & PERIOD COVERED Final Report, 11Apr83
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Cpt. Robert G. Boyko		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS HQDA, MILPERCEN, ATTN:DAPC-OPP*E 200 Stovall ST. Alexandria, Va. 22332		12. REPORT DATE 11 April 83
		13. NUMBER OF PAGES 82
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Initial Entry Training, Weight Training, Calisthenics
Army Physical Fitness Program in XXXXXXXXInitial Entry Training
Pushups, Physical Readiness Training

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The United States Army has always been concerned with the physical fitness of its soldiers. One component of physical fitness is upper body strength and muscular endurance. This investigation attempted to find the most effective program for developing upper body strength and muscular endurance by comparing the effectiveness of the current Army physical training program used in Initial Entry Training with four other

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supplemental programs.

The subjects for this investigation were 214 Army recruits undergoing Initial Entry Training at Fort Knox Kentucky, The training period was seven weeks long. The subjects were divided into five groups; a daily and alternate day weight training group and a daily and alternate day calisthenic group and a group doing the current Army training program. The soldiers in all five groups were tested in three tests; the pushup test, the one repetition maximum bench press test, and the 75% of one repetition maximum bench press test. A pre-test, a midcycle test and a post-test were given. The results showedthat althrough every experimental group did better than the group using the current Army program none of them did significantly better on the pushup test. The weight training groups did significantly better than the nonweight training groups on the bench press tests. There were no significantly different results between the daily training group and the alternate day training group.

Comparison of Weight Training and Calisthenic Exercise Programs in Developing Strength and Muscular Endurance in United States Army Recruits

Robert G. Boyko 03
HQDA,MILPERCEN DAPC-OPP-E
200Stovall Street
Alexandria,VA 22332

Final Report 11 April 1983

A thesis submitted to The Pennsylvania State University ,University Park, Pennsylvania in partial fulfillment of the requirements for the degree of Master of Science.

(2)

The Pennsylvania State University

The Graduate School

Department of Physical Education

Comparison of Weight Training and Calisthenic Exercise Programs in Developing Strength and Muscular Endurance in United States Army Recruits

A Thesis in

Physical Education

by

Robert George Boyko

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Master of Science

May 1983

We approve the thesis of Robert George Boyko.

Date of Signature:

3-21-83

Chauncey A. Morehouse

Chauncey A. Morehouse, Professor of Physical Education, Thesis Adviser

3-21-83

Robert W. Christina

Robert W. Christina, Professor of Physical Education

3-21-83

Richard C. Nelson

Richard C. Nelson, Professor of Physical Education

3/28/83

Lucille I. Magnusson

Lucille I. Magnusson, Professor of Physical Education, In Charge of the Graduate Program in Physical Education

ABSTRACT

The United States Army has always been concerned with the physical fitness of its soldiers. One component of physical fitness is upper body strength and muscular endurance. This investigation attempted to find the most effective program for developing upper body strength and muscular endurance by comparing the effectiveness of the current Army physical training program used in Initial Entry Training with four other supplemental programs.

The subjects for this investigation were 214 Army recruits undergoing Initial Entry Training at Fort Knox, Kentucky. The training period was seven weeks long, which is the length of Initial Entry Training. The subjects were divided into five groups: the current Army training program group, an alternate day calisthenics group, a daily calisthenics group, an alternate day weight training group, and a daily weight training group. The soldiers in all five groups were tested on the pushup test, the one-repetition maximum bench press test, and the 75 percent of one repetition maximum bench press test. The tests were given on three occasions: before the start of training, in the middle of the training period, and at the conclusion of the seven-week training period.

The results of the investigation showed that there were no significant differences between the five groups on the pushup test at the end of the seven-week training period. There were significant

differences between both weight training groups and the alternate day calisthenic group on the bench press tests. There were no significant differences between the daily and alternate day training groups on any of the three tests at the end of the seven-week training period.

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ACKNOWLEDGMENTS

The writer wishes to express his sincere appreciation to Dr. Chauncey A. Morehouse for his excellent guidance and continued encouragement throughout this study.

The writer is also grateful to Dr. Robert W. Christina and Dr. Richard C. Nelson for their valuable suggestions and assistance in the preparation of this manuscript.

CHAPTER I

INTRODUCTION AND STATEMENT OF PROBLEM

The advent of modern weapons such as the airplane and the tank has not lessened the need for physically fit men and women in the armed forces. If anything, the need for physical fitness is greater today because wars are now fought without regard to the time of day or season of the year, and may be waged in any type of climate. Being physically fit does not simply give a soldier the physical ability to meet the challenges he may face in times of war or peace, it constitutes an important psychological factor as well. A physically fit soldier is apt to be a more confident soldier who almost always performs his job better. In a 15-year study of the relationship between physical ability and academic and military success at the United States Military Academy at West Point, it was found that there was a significant and positive relationship between success in physical areas and success in academic and military pursuits within the Corps of Cadets. There was also a significant and positive correlation between failure in physical education and failure in academic and military subjects.[1] Whether in the military or in a civilian job, physical fitness reduces illness and absenteeism and generally makes life more enjoyable.

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[1]H. Harrison Clarke, "The Totality of Man," The Physical Fitness Research Digest, 1 (October 1971), 6.

The physical training of a soldier starts at the time he enters basic training, now called Initial Entry Training. Initial Entry Training was the setting for this research. The objective of the physical training program for Initial Entry Training is to give the new soldier an intensive, all-around physical development program which will develop in the soldier those qualities, capabilities, and reflexes associated with excellent physical condition.[2]

The physical training program is basically the same for all soldiers in Initial Entry Training although females are required to do fewer repetitions and run shorter distances than males. Local commanders can add to but cannot subtract from the time spent on physical training or its intensity. The current physical training program as outlined in the program of instruction for Initial Entry Training requires that physical training be conducted six days a week, each period consisting of about 30 minutes of calisthenics and a 20- to 30-minute run. In that hour, exercises for developing arm and shoulder strength and endurance which were the focus of this study consist of pushups or pullup exercises done four times, each time to exhaustion. In addition, commanders are encouraged to have their soldiers do exercises whenever possible during the training day and to conduct remedial training for soldiers who are not making satisfactory progress.

In 1979, the Army switched from the five-event to the three-event physical fitness test. This shortened test consists of the

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[2]William A. Koski, "An Analysis of the Army Specialized Training Program's Physical Fitness Tests," (unpublished master's thesis, The University of Oregon, Eugene, Oregon, 1954), pp. 1-7.

pushup exercise, the situp exercise, and a two-mile run. This study was concerned only with the pushup portion of that test.

The pushup was purported to test strength and muscular endurance of the arm, shoulder, and chest muscles, referred to as the upper body in this manuscript. The Army recruit has to do 68 pushups (at the end of seven weeks of training) to obtain a maximum score of 100 points on the physical fitness test. He has to do a minimum of 30 pushups in order to graduate from Initial Entry Training and has to be able to do 40 pushups four weeks later in order to graduate from Advanced Individual Training. The scores are based on a graduated scale according to age and sex. They do not consider body height, weight, or arm length as some modifications of the pushup test do. The standards for the pushup are strict--any bend in the back or failure to fully extend the arms will result in that repetition not being counted. The subject has two minutes to do as many pushups as he can; if the knees touch the ground before the two minutes are finished, the exercise is terminated. Recent studies have shown that the pushup portion of the final physical fitness test is the most often failed part of any test administered in Initial Entry Training.[3] Therefore, a program that improves pushup performance will be valuable to the Army and may also be valuable to general civilian physical education programs.

The task of developing upper body strength and muscular endurance in seven weeks is a challenging one. Time is very limited, and

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[3]Colonel Donald Smart, "Physical Fitness Training," Commander's Notes, 17, (May 1981), 6.

individualized programs and instruction are almost impossible. Furthermore, there are only two drill sergeants for every 45 to 55 soldiers, and there is usually a wide disparity in the physical condition within each group of soldiers; e.g., a few who already can do the 68 pushups required for a maximum score and some who cannot even do one correct pushup. In addition, physical training equipment, facilities, and up-to-date literature are usually in short supply.

Despite these obstacles there are a few key advantages to training a group such as the Initial Entry Training soldiers in this study. As a group they are all volunteers for the Army, they have all passed strict medical examinations before being accepted in the Army, they are highly motivated to improve their physical condition, and they are under the total control of their drill sergeants who train the recruits during the seven weeks of Initial Entry Training.

Considering the strong emphasis on physical fitness in the Army and the strengths and weaknesses of the current Army physical training employing methods which are not well validated, it appeared that a research project under field conditions designed to develop upper body strength and muscular endurance of Army soldiers was warranted. The problem of finding the optimum combination of type of exercises and exercise frequency was the principal reason for undertaking this study. The writer desired to investigate whether calisthenics and weight training performed daily or every other day would have different effects on the development of upper body strength and muscular endurance.

Statement of the Problem

The purposes of this study were to compare: a) the effectiveness of calisthenic exercises and weight training in the development of upper body strength and muscular endurance as measured by the bench press and pushup tests, and b) the effects of these training programs when administered daily or every other day on the improvement of upper body strength and muscular endurance of United States Army recruits.

Delimitations of the Study

This study was limited to 214 male soldiers undergoing Initial Entry Training at Fort Knox, Kentucky, from 23 August 1982 to 10 October 1982. The experimental period was limited to seven weeks of training, which was the length of Initial Entry Training. The study was limited to upper body strength and muscular endurance as measured by the bench press and pushup test.

Limitations of the Study

The sample in this study was divided into five groups. Although each group followed meticulously the program outlined, individual differences in instructors (drill sergeants) may have resulted in varying amounts of emphasis being placed on different aspects of the program. The manner in which the exercises were done may have influenced the final results of this investigation.

It was assumed that the soldiers in the study were motivated to perform each test to the maximum of their ability. To encourage this maximum effort, incentives in the form of group competition, group

privileges, and individual awards were used; but the effort exerted by each soldier could not be measured.

Significance of the Study

Today the Army's literature on physical fitness appears to be outdated or very sparse. Most of the exercise program currently being used traces its origin back to studies done during the Second World War. No scientific studies appear to have been done in the military comparing the advantages and disadvantages of daily or every other day exercise. Also the value of weight training versus calisthenics has not been studied in the military. The studies to date have involved small samples using very limited exercise programs. The application of the results of these studies to Army training and its rigorous physical demands is questionable. It was believed that this study would give Army authorities useful data concerning the value of calisthenics and weight training in the Army physical training programs and determine whether daily or every other day physical training is better for developing upper body strength and muscular endurance. The results of this study should provide Army commanders with more scientific information in order to provide for more effective use of the limited physical training time available during the United States Army's Initial Entry Training.

Definition of Terms

The following terms were defined for the purpose of this study:

Strength is the amount of force a muscle can exert in a single contraction.[4]

Muscular endurance is the ability of the muscle or muscles to continue work either by sustaining a contraction or by continuing to lift and lower a submaximal load.[5]

Relative muscular endurance is the ability of the muscle or muscles to continue work by continuing to lift and lower a submaximal load which is a given percentage of the total load that an individual can lift for one repetition.[6]

Strength-endurance index is a performance measure of the 75 percent of 1RM bench press test equal to the change in weight lifted from the pre-test to the post-test divided by five plus the change in repetitions done from the pre-test to the post-test.

Upper body strength is a measure of the ability of the arm, shoulder, and chest muscles to exert a force.

Exercise to exhaustion is the condition existing when a muscle is fatigued to the point where it can no longer complete a correct repetition of an exercise.

Calisthenics are exercises done using only the weight of the body as resistance.

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[4]H. Harrison Clarke, "Physical Fitness Practices and Principles for Education," The Physical Fitness Research Digest, 6, October 1976, 8.

[5]Ibid.

[6]Ibid.

CHAPTER II

SURVEY OF LITERATURE

This chapter includes a survey of selected literature on the development of muscular strength and endurance pertinent to this investigation. It is divided into five sections: literature related to a) the development of strength and muscular endurance, b) fatigue and the effects of exercise frequency and intensity on it, c) the pushup exercise, d) calisthenic and weight training exercise programs, and e) a summary of the literature presented.

Muscular Strength and Endurance

Improvement of strength and muscular endurance are desirable goals of any military conditioning program. Unfortunately, despite numerous studies of these attributes there has been little agreement concerning the fastest and most effective method of developing both simultaneously.

DeLorme[7] is considered by many to be the father of modern strength training. In the 1940's he developed a method of weight training which was based on what he called the "overload principle." He believed that increasing the number of repetitions of an exercise or increasing the amount of resistance by adding weight was necessary in order to

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[7] T. L. DeLorme and A. L. Watkins, "Techniques of Progressive Resistance Exercises," The Archives of Physical Medicine and Rehabilitation, 29 (May 1948), 205-213.

progressively strengthen muscles. He felt that muscles would reach a certain level of strength and endurance without changing the amount of resistance but the muscles would not improve beyond that point unless they were overloaded by increasing the resistance or by performing more repetitions. The overload principle is still the basic principle upon which most strength building programs are based.

Berger,[8] who has done a number of studies on strength development, conducted a study of weight training in 1961. He had two groups train three days a week for a period of 12 weeks. One group trained statically employing isometric exercises, and the other group trained using dynamic methods utilizing exercises with weights. Both groups were tested at the end of the 12-week training period by two tests. One test was on the back-pull machine which tested static strength; the other test was a dynamic strength test of the back muscles. Berger found that the group that trained dynamically did better on the dynamic test while the group that trained statically did better on the static test. These findings led him to conclude that the development of strength was very specific. He believed best results would be obtained if an individual trained his muscles in the way he intended to use them.

Ross[9] tested Berger's idea at the University of Arkansas in a test involving male members of the university swim team. Ross duplicated

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[8]Richard A. Berger, "Static and Dynamic Strength Increases," The Research Quarterly, 33 (October 1962), 329-333.

[9]Delan T. Ross, "Selected Training Procedures for the Development of Arm Extension Strength and Swimming Speed of the Front Crawl Stroke," (unpublished doctoral dissertation, University of Arkansas, Little Rock, Arkansas, 1970), 1-60.

the exact movement necessary for the crawl stroke and developed a pulley system which provided varying amounts of resistance during the movement. He found that the group which trained with the resistance equipment performed significantly better than the control group which trained by doing the crawl stroke with only water as resistance. He concluded that resistance training was more effective in developing strength, if the exact test movements could be duplicated in the training program.

DeVries[10] outlined eight principles of strength development based on his research and his analyses of research done by others. A summary of the eight principles is as follows: a) the overload principle must be utilized to build strength, b) strength gains are specific to the angle in the range of motion of a muscle, c) the rate of gain is most rapid when a muscle has achieved only a small proportion of its possible maximal end strength, d) once strength is attained it can be maintained with as little as one workout per week, e) the strength of any muscle is a result of the quantity and quality of muscle tissue, f) strength testing should be done under constant conditions, g) strength is best developed with no less than three workouts per week and no more than four workouts per week, and h) only one workout per week should be allotted where complete muscle exhaustion is the goal.

Tuttle,[11] in studying 23 males aged 24 to 46 years, compared the

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[10]Herbert A. DeVries, Physiology of Exercise for Physical Education and Athletics, 1st ed. (Dubuque, Iowa: William C. Brown, 1966), pp. 317-318.

[11]W. W. Tuttle, C. D. Tanney, and T. V. Salvano, "Relation of Maximum Back and Leg Strength to Back and Leg Endurance," The Research Quarterly, 26 (March 1955), 96-102.

development of strength and muscular endurance of the back and leg muscles by using a dynamometer which measured strength and also muscular endurance by recording the amount of force applied with each repetition of the test exercise. Muscular endurance was defined by Tuttle and his associates to be the average force applied over 90 seconds.

From the results, Tuttle and his colleagues concluded that: a) individuals with the greatest strength also had the greatest absolute muscular endurance; b) strong individuals maintain a smaller proportion of their maximum back and leg strength in endurance efforts; c) muscular endurance is not directly proportional to strength, in fact, relative muscular endurance is inversely proportional. Individuals who are superior strengthwise, in fact, appear to have lower relative endurance when compared to weaker individuals. This last point generated a controversy that has still not been conclusively resolved.

Shaver[12] is one researcher who disputed Tuttle's finding on relative endurance. He conducted tests of the strength of the flexor muscles of the forearm using 120 college males. His subjects were divided into three groups: a strong group, a middle group, and a weaker group based on the maximum strength measured isometrically using a cable tensiometer. He further tested each group for relative endurance by recording the time each subject could maintain a set pace of 30 cranks a minute on a lever ergometer. The loads placed on the

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[12]Larry G. Shaver, "Relation of Maximum Isometric Strength and Relative Isotonic Endurance of the Elbow Flexors of Athletes," The Research Quarterly, 43 (March 1972), 82-88.

ergometer were 35, 40, and 45 percent, respectively, of the maximal strength of each individual tested. A different percentage was used for each of three consecutive days and the average time was found for each individual based on the three trials.

From his research Shaver concluded that contrary to Tuttle's findings, there was a positive and significant relationship between maximal strength and relative endurance. The stronger subjects were also able to perform the exercise longer even though they were exercising against mean resistances that were greater in absolute terms than the ones the weaker group used.

Kincaid[13] in a study of 15 college males at The Pennsylvania State University had his subjects lift a light weight of 19 pounds by flexing their arm while it rested on an inclined surface. He had each of his groups train at different rates of speed, and he found at the end of the five-week training period that the group which trained at the fastest rate of speed was able to continue to exercise significantly longer than the other groups regardless of the pace of the test. From these results, he concluded that the faster the rate of exercise, the greater was the gain in endurance.

Noble and McCraw[14] in a study of isometric and isotonic weight training and calisthenic conditioning programs involving college-age

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[13]Donald G. Kincaid, "The Specificity of Muscular Endurance Following Different Rates of Training," (unpublished master's thesis, The Pennsylvania State University, University Park, Pennsylvania, 1959), pp. 1-53.

[14]Larry Noble and Lynn W. McCraw, "Comparative Effects of Isometric and Isotonic Training Programs on Relative-Load Endurance and Work Capacity," The Research Quarterly, 44 (March 1973), 96-107.

men and women found that the success of each program varied widely according to the individual. They stated that based on their research there was no single method that was adequate for achieving both strength and endurance. They also concluded that weight training involving heavy weights and low repetitions best developed strength while a program of calisthenics or weight training with light weights and numerous repetitions was best for developing muscular endurance.

Clarke assessed the relationship between strength and muscular endurance as follows:

a) The amount of resistance required to induce muscular exhaustion in a short time varies among individuals depending on the strength of the muscle involved.

b) The work output in exhaustion performance is greater when the muscles are in position to apply greatest tension at the point of greatest stress.

c) There appears to be a specific combination of load and speed of movement which produces the maximum work output of each muscle group.

d) Individuals with the greatest muscular strength tend to have the greatest endurance but stronger muscles tend to maintain a smaller proportion of maximum strength in endurance events than weak ones.

e) The immediate effect of muscular fatigue is to reduce the ability of the muscle to apply tension. The amount of this decrement is an indicator of the degree of muscular fatigue.

f) The strength decrement of involved muscle groups may be used to determine total body muscular fatigue and may serve as a criteria for evaluating the effects of such an activity on the body as a whole.[15]

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[15]H. Harrison Clarke, "Towards a Better Understanding of Muscular Strength," The Physical Fitness Research Digest, 3 (January 1973), 10-11.

Fatigue and the Effects of the Intensity and Frequency of Exercise on Fatigue

Fatigue

Muscular fatigue and its causes have been studied by a number of researchers. At this time there is no widespread agreement as to the cause or causes of muscular fatigue. Three theories on fatigue are presented in this section.

Watkins espoused the belief that fatigue may be more of a psychological process than a physiological one. He stated:

> The anti-genetic control of muscular response in which the muscle through the Golgi tendon organ acts to inhibit its own muscle contribution protects the muscle against injurious degrees of tension. This coupled with mental inhibition during works of a voluntary nature means that the individual operates under a wide margin of safety and under ordinary and normal circumstances will stop working long before he is in the danger zone of trauma from complete exhaustion.[16]

DeVries[17] theorized that fatigue in muscles was caused by tonic muscle spasms, and if his hypothesis was correct, stretching after exercise bouts would relieve the soreness and enhance recovery. He tested this theory using 17 subjects, 15 males and two females, aged 20 to 29 years, who exercised for four-minute periods using a 9.5-pound bar which they curled while their arms were extended over an inclined board. While the right arm for each subject was stretched for one

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[16]Alan L. Watkins, "Scientific Foundations of the Overload Principle," Scholastic Coach, 27 (April 1958), 20.

[17]Herbert A. DeVries, "Prevention of Muscular Distress After Exercise," The Research Quarterly, 32 (May 1961), 177-185.

minute following each exercise bout, the left arm acted as the control and was not stretched after the exercises. DeVries reported that in 15 subjects the stretched arm felt better than the control arm. This led DeVries to conclude that the spasm theory had some validity.

Yakovev,[18] a Soviet physiologist and trainer of Olympic athletes, after reviewing Soviet research on training frequency and intensity, developed the theory that there were two types of fatigue. The first which he called rapidly developing fatigue is caused by short intense exercise bouts, similar to the pushup exercises employed in this study. This rapid fatigue is caused by the accumulation of lactic acid, exhaustion of the rapid energy resources, and disruption of the ATP balance in the working muscles. Recovery from this type of fatigue can be achieved rapidly by giving the involved muscles relatively short rest periods of two to four hours in duration and by light exercise and stretching. The slow developing fatigue called general body fatigue is caused by intense training over a longer period of time, lack of sleep, or insufficient food. It is characterized by extreme overall fatigue but the actual physiological cause is not known. Yakovev felt that only complete rest for a longer interval, 72 to 120 hours, will alleviate this type of fatigue. From this review of Soviet research, he concluded that optimum results in physical conditioning are obtained by frequent short-term, high-intensity workouts.

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[18]N. N. Yakovev, "Fatigue in Sports: Its Basis and Its Significance," Soviet Sports Review 14 (September 1979), translated by Michael Yessis, Los Angeles: Peter's Printing and Publication (October 1981), 105-108.

Despite the lack of agreement as to the exact cause or causes of fatigue, most coaches and physiologists agree that the intensity and the frequency of exercise has a definite bearing on the amount of fatigue and the length of the recovery period required after exercise in order to insure optimal results from a conditioning program.

McGlynn[19] was one of the few researchers to try a twice-a-day training routine in his test of the optimum frequency of exercise. His sample consisted of 60 college-age males divided into three experimental groups. One trained every other day, one group trained every day, and one group trained twice a day. The training involved an isometric contraction of the biceps muscle that was held for a two-minute period. He tested his subjects weekly on a cable tensiometer and found that the twice-a-day training group improved up to the end of the third week when most of them reached a strength plateau. After that time average strength for that group declined until the end of the experiment. Although McGlynn could not conclusively identify the reasons for the decline, he felt that twice-a-day training involving strenuous exercise did not give the muscles enough time to recover between exercise bouts and actually was detrimental to developing strength.

Johnson[20] looked at exercise frequency over a longer term. He conducted a study of 2,000 high school students over a two-year period

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[19]George H. McGlynn, "Effects of Isometric Exercise on Fatigue in the Skeletal Muscle," The Research Quarterly, 39 (March 1968), 131-136.

[20]LaVon C. Johnson, "Effects of 5 Day a Week vs. 2 and 3 Day a Week Physical Education Classes on Fitness, Skill, and Adipose Tissue and Growth," The Research Quarterly, 40 (March 1969), 93-98.

to see whether two-, three-, or five-day-a-week training using the same format was better for developing fitness. His fitness test consisted of pushups, 100-yard dash, 600-yard run, broad jump, jump and reach, and situps. The test was given at the start and end of each school year. His findings seemed to indicate that daily physical education was more effective in building physical condition than the other two frequencies.

In a study of short-term rest intervals after exercise, McCafferty and Horvath[21] tested the theory that the harder a muscle worked, the longer the period of rest that was needed. They had a group of subjects do isotonic lifts using different weights thereby varying the intensity of the workouts. They tested each subject after each exercise on a force dynamometer at intervals of 10 seconds up to a period of three minutes to see how long it took the exercised muscles to recover their full pre-exercise strength. They found that their theory appeared to be correct: the more weight lifted, the longer was the rest interval needed to recover full strength. They concluded that rest intervals had to be tailored to the exercise being done.

Most studies on the intensity and frequency of exercise have involved either aerobic conditioning or the use of calisthenics and light weights. Sitler[22] addressed the question of the effect of

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[21]William B. McCafferty and Steven M. Horvath, "The Specificity of Exercise and the Specificity of Training: A Subcellular View," The Research Quarterly, 48 (May 1977), 358-366.

[22]Michael R. Sitler, "Three vs. Five Day a Week Training With Isokinetic Exercises," (unpublished master's thesis, East Stroudsburg State College, East Stroudsburg, Pennsylvania, 1977), pp. 1-45.

exercise done with heavy weights at near-maximal levels of work. His 10-week study involved 32 male college students who trained the leg muscles with heavy loads to exhaustion on a Cybex machine. He divided his sample into two groups, one of which trained three days a week and the other five days a week. The intensity and duration of each exercise period was the same for both groups, so the total amount of training was greater for the five-day training group than the three-day training group.

Sitler found that the five-day training group made faster gains in strength as measured by weekly tests conducted with the Cybex machine. But after three weeks the daily training group appeared to reach a strength level at which they gained no further and in some cases declined in strength. By the end of the 10-week training period, the strength gains of the three-day a week training group were significantly greater than the five-day a week training group. These findings seem to suggest that more training may not necessarily be beneficial and that every other day exercise periods may be superior to every day training.

The Pushup

The Army has used the pushup as the test of upper body strength and endurance since December 1979. In designing a program for improving performance in the pushup exercise, this researcher felt that a review of the literature on the pushup exercise and the development of the muscles necessary to do pushups was warranted.

Scott explained the exact movement of the pushup exercise as follows:

> The downward movement is controlled by the wrist, elbow, and shoulder. The flexor carpi radialis, flexor carpi ulnaris, and palmaris longus prevent too rapid extension of the wrist. The triceps govern elbow flexion. At the shoulder the pectoralis major, coracobrachialis, teres major, and latissimus dorsi are acting. The scapula is fixed by the rhomboids, serratus anterior, trapezius, and pectoralis minor. The subclavis depresses the clavicle. The same arm muscles extend again and the rhomboids, trapezius, and pectoralis minor adduct and rotate the scapula downward.[23]

McCraw and McClenney[24] tested the theory that improvements noted by many researchers on physical fitness tests were not completely due to the treatments but were also due in part to the skill acquired by doing the exercises. To test this theory they had a group of high school students do a number of physical fitness tests every other day for a period of two weeks. They found that by the fourth trial of pushup exercises the scores had improved significantly. They felt that the results showed that practice in the execution of the pushup exercise was almost as valuable as any conditioning program for it.

Generally the correlations between the maximum number of pushups performed and upper body strength and muscular endurance have been moderately positive when the tested individual's weight and arm length were not factored out and highly positive when these factors were considered in the results. Clarke[25] analyzed the relationship between

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[23]M. Gladys Scott, Analysis of Human Motion, (New York: F. S. Croft, 1942), p. 372.

[24]Lynn W. McCraw and Byron McClenney, "Reliability of Fitness and Strength Tests," The Research Quarterly, 36 (October 1965), 289-295.

[25]H. Harrison Clarke, "Relationship of Strength and Antropometric Measures to Various Arm Strength Criteria," The Research Quarterly, 25 (May 1954), 134-143.

nine tests of strength and muscular endurance and five anthropometric measurements in a 1954 study for the military. The subjects of the test were college athletes. The results were compared against a test of strength using a cable tensiometer. Clarke found that the pushup correlated moderately with muscular endurance and strength (r=.466) but correlated significantly better (r=.870) if McCloy's arm strength formula was utilized so that the weight of the individual was taken into consideration. As a result of the study, Clarke concluded that the pushup was a measure of relative endurance in which the number a person could do depended on a variety of factors, the most significant being strength, muscular endurance, motivation, body weight, and arm length.

McCloy,[26] two years later, conducted a study of physical fitness tests for the Army which involved 400 soldiers who had physically trained for six months prior to the tests. He compared ten individual fitness tests with four physical attributes: circulorespiratory endurance, speed of muscular contraction, muscular strength, and muscular endurance. McCloy found the correlation between the number of pushups which could be performed and muscular endurance was (r=.57). He concluded from his study that the pushup was a reasonably good measure of upper body muscular endurance even without weight and arm length considered.

Eckert and Day[27] studied the correlation between strength and

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[26]C. H. McCloy, "A Factor Analysis of Tests of Endurance," The Research Quarterly, 27 (May 1956), 213-216.

[27]Helen M. Eckert and June Day, "Relationship Between Strength and Workload in Pushups," The Research Quarterly, 38 (October 1967), 380-383.

the pushup exercise. Their study consisted of 15 well-conditioned college women (well-conditioned being defined as an individual who could do at least 41 knee pushups in one minute). The calculations of maximal arm strength in the high and low pushup position plus the weight of the subject were recorded for each individual. The strength measures were recorded by a cable tensiometer. Work load was calculated as the distance between the high and low pushup positions for each subject, and the number of pushups that subject could do until exhausted.

Eckert and Day found a correlation coefficient of 0.76 between the calculated maximal strength measure and the workload. This showed that strength was an important factor in pushup performance.

Hinson[28] did an electromyographic study of the muscles involved in the pushup exercise. The study involved 20 subjects chosen from a sample of 156 college women. Ten of the subjects which comprised Group 1 could do at least ten full pushups. Another ten women who could not do five knee pushups comprised Group 2.

Her study revealed that the pushup exercise involved in order of importance: the anterior deltoid muscle, the triceps, the trapezius, and the pectoralis major. In addition, she found that whereas strength was a factor that differentiated one group from the other, the analysis indicated a greater amount of muscular involvement in the low strength group than in the strong group. This implied that lack of efficiency and coordination had an effect on pushup performance in addition to a

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[28]Marilyn M. Hinson, "An Electromyographic Study of the Pushup for Women," The Research Quarterly, 40 (May 1969), 305-311.

lack of basic strength. Hinson felt that in addition to building strength in an effort to improve pushup performance, work should be done to insure the exercise is done correctly because correct execution will make the exercise easier. Hinson also found that the let-down pushup, knee pushups, and the isotonic bench press were good methods of improving pushup performance.

Calisthenic and Isotonic Exercise Programs

In this section the research on calisthenic exercise programs and isotonic exercise programs as they pertain to upper body strength and muscular endurance are summarized.

Calisthenics

The first type of exercises to be discussed is calisthenics, which was previously defined as exercises that use only the weight of the body for resistance.

Campney and Wehr[29] outlined the trend of exercise in America, and they found that calisthenics have enjoyed a cyclical popularity. They first appeared in the 19th century, became popular in the post-World War I era, then fell into disfavor with the beginning of the widespread use of weight training for exercise after the Second World War. They became popular again due to the publicity they received from the President's Council on Physical Fitness and the publication of Cooper's Royal Canadian Exercise Plan in the early 1960's.

Knutzelman stated the key advantages of calisthenics are:

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[29]Harry K. Campney and Richard W. Wehr, "Effects of Calisthenics on Selected Components of Physical Fitness," The Research Quarterly, 36 (December 1965), 393-402.

a) Calisthenics are relatively easy to learn and perform.

b) Very little equipment or space is needed.

c) A vigorous workout can be achieved in a short time.

d) Almost all muscle groups can be developed.

e) Calisthenics can be performed individually or in groups of all sizes.[30]

Despite all these advantages, in The Encyclopedia of Physical Education, Fitness, and Sports it was stated that many physical educators dislike calisthenic programs because they feel individuals do not exert themselves sufficiently to receive maximum benefit from the exercises, calisthenics do not have the visual and motivational feedback of increasing weights as do weight lifting programs, and physically fit individuals eventually need to work against increasing resistance to obtain maximum benefit.[31]

In a study of the United States Army's Physical Training Program during the Second World War, Wieman[32] studied the physical training of over 2,000 recruits, aged 18 to 32 years. The pre-test and post-test consisted of pushups, squat jumps, situps, pullups, 100-yard sprint, squat thrusts, and a 300-yard shuttle run. The recruits trained for a period of 12 weeks for six hours a week divided into three, two-hour

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[30]Charles T. Knutzleman, Rating the Exercises, (New York: William Morrow, 1978), p. 181.

[31]Thomas K. Cureton (ed.), Encyclopedia of Physical Education, Fitness, and Sports, 2nd ed, (New York: Brighton Publishing, 1980), p. 372.

[32]E. E. Wieman, "Some Results of Physical Training Under the Army Specialized Training Program," The Research Quarterly, 16 (May 1945), 87-94.

training periods. This training consisted of calisthenics and runs from one-half to two miles. At the end of the 12-week training program, the group as a whole improved significantly in all areas with the greatest gains being made on the pushup, situp, and pullup parts of the test. These findings helped to validate the Army's physical training program.

Wright[33] studied the effects of four physical training programs on the physical fitness of adult women. He had five groups: an aerobic dancing group, a weight training group, a calisthenic group, a group that played volleyball, and a control group that did not participate in any physical activity. Each group trained for 50 minutes a day, three days a week, for a period of ten weeks. Of the five groups, he found the calisthenic group improved the most on the AAPHER test.

Thompson[34] in a detailed study of physical conditioning at The Pennsylvania State University studied the effects of a weight training program and a calisthenic program on male college students who scored poorly on an initial physical fitness test. His sample was divided into three groups: a calisthenic group, a weight training group, and a control group. The calisthenic and weight training groups each exercised for 55 minutes a day, three days a week, for ten weeks. The weight training group performed the test items: a) a vertical

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[33]Owen L. Wright, "The Effects of Training on the Physical Fitness of Adult Women," (unpublished master's thesis, The University of Illinois, Urbana, Illinois, 1961), pp. 50-104.

[34]James G. Thompson, "Relative Effects on Physical Condition of a Regular Weight Training Program and a Specially Designed Conditioning Program," (unpublished master's thesis, The Pennsylvania State University, University Park, Pennsylvania, 1964), pp. 1-60.

jump, b) chinups, c) shuttle run, and d) the situp as a part of its training program although they did fewer repetitions than the calisthenic group. By having the weight training group also practice the test items, Thompson felt that skill in execution of the events as a factor in the results would be minimized.

Both the weight training group and the calisthenic group did significantly better than the control group on the final test. The calisthenic group also did significantly better than the weight training group. From this result, Thompson concluded that weight training was not necessary to improve the strength of low fitness individuals.

Weight Training Programs

The second type of physical training in the current study was weight training. Weight training has received widespread attention by physical educators, physiologists, and physical fitness researchers.

Chui[35] investigated the effect of weight training on what he called measurements of power in an effort to find if weight training reduced the speed and flexibility needed in sports involving power which was a common belief at that time by coaches and physical educators. He had 45 subjects, all males from 17 to 32 years of age. He divided his sample into two groups; one group of 23 trained on a 12-exercise weight training program for 12 weeks. The other group of 22 subjects was the control which did no training. Chui tested his

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[35]Edward Chui, "The Effects of Weight Training on Athletic Performance," The Research Quarterly, 21 (October 1950), 188-192.

subjects before the start of the 12-week program and again at its conclusion. His test events were: a) the Sargeant's jump test from a standing start, b) the Sargeant's jump test from a running start, c) the standing broad jump, d) the eight-pound shot put, and e) the 60-yard sprint.

The results of the post-test showed that the weight training group performed significantly better than the control group on all the test measures. Since the groups were equal on the pre-test, Chui concluded that weight training had improved the performance of the weight training group. Furthermore, weight training had no adverse effects on speed or jumping ability. It enhanced rather than hurt performance and therefore weight training programs should help performance in sports requiring speed and jumping ability. Since Chui's study, several other studies have confirmed his findings and the use of weight training to improve athletic performance now enjoys widespread popularity.

Berger[36] conducted a study of weight training methods which involved 199 college-age men over a period of 12 weeks. He divided his sample into groups according to the number of repetitions they were to do during training on the bench press exercise. The subjects in the respective groups performed from one to a total of 12 repetitions per exercise with the heaviest weight each individual could lift to do the required number of repetitions. Each group exercised three

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[36]Richard A. Berger, "Optimum Repetitions for the Development of Strength," The Research Quarterly, 33 (October 1962), 334-339.

days a week, but the total number of repetitions weekly was the same for all groups.

From his study Berger concluded that the optimum number of repetitions was between three and nine, and strength was best gained by using heavy weights and low repetitions while endurance was best gained by performing a large number of repetitions using lighter weights.

Westcott[37] studied the effects of varied frequencies of weight training on college men. He divided his subjects into five groups, one of which trained one day a week, one trained twice a week, one trained three days a week, one trained five days a week, and the control group which did no training. Each group did the same number of repetitions per week. He tested the groups at the end of the six-week training period and found no significant differences between the groups that trained with weights. From these findings he concluded that as long as total work is held constant the frequency of exercise has no effect if it is done at least weekly.

Shepard[38] compared the effects of isotonic, isokinetic, and negative resistance strength training using only the bench press exercise. This study involved 91 college-age males divided into seven groups. Three groups did three sets of eight repetitions, three

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[37]Wayne L. Westcott, "Effects of Varied Frequency of Weight Training on the Development of Strength," (unpublished master's thesis, The Pennsylvania State University, University Park, Pennsylvania, 1974), pp. 20-61.

[38]Gregory A. Shepard, "Comparison of the Effects of Isotonic, Isokinetic, and Negative Resistance Strength Training Programs," (unpublished doctoral dissertation, Brigham Young University, Provo, Utah, 1975), pp. 68-76.

groups did three sets of three repetitions, and one group, the control, did no training. One group in each of the different repetition groups did isotonic training, one group did isokinetic training, and one group did negative resistance training. The strength tests were conducted using a cable tensiometer. Shepard found that all six training groups improved significantly over the eight weeks of training with none apparently being better than the others. Shepard also found that regardless of the training method, nonexperienced subjects improved more than experienced lifters.

Summary of the Literature

The development of strength and muscular endurance has been studied by a number of researchers with a variety of results. DeLorme who is considered by many to be the father of modern strength training first used the phrase "overload principle." This principle has been the cornerstone for most modern strength training programs. The "overload principle" in essence states tnat a muscle must be progressively stressed in order for it to develop strength to its fullest potential. Berger and Ross found that the method of training had a significant effect on the type of strength and muscular endurance developed. In order to improve performance in a certain event, they believed it is necessary to duplicate that event as closely as possible in resistance training.

The optimum method for developing muscular endurance is less clearly understood than the methods for developing strength. Tuttle felt that the stronger a person was the less relative endurance he developed. Others have disputed this theory. Kincaid felt the speed

of workouts had a significant effect on developing muscular endurance, while Noble and McCraw concluded from their research that light weight training or calisthenics developed endurance most efficiently.

In studies of the frequency and the intensity of exercise and its effect on fatigue and performance, there are no clear indications of the best type of training. Frequency of training and intensity of training appear to be related; if you increase one significantly, you most often have to reduce the other. It seems the optimum combination of frequency and intensity differs with type of activity. A key question in the intensity and frequency debate is whether everyday or every other day training is more productive in developing strength and muscular endurance. Johnson believed that calisthenics were best when done every day, while Sitler found every other day training best with heavy weight training. The central point seems to be that more training is not necessarily better and intense workouts must be balanced by sufficient rest in order to achieve optimum results.

The literature describes the pushup as a complex exercise involving primarily the muscles of the arms, shoulders, and chest. According to Clarke and Eckert and Day, strength and pushup performances are positively correlated. Clarke and McCloy also found the pushup to be a good measure of muscular endurance. It appears that skill is very important in the execution of the pushup. Hinson, in an electromyographic study of the pushup, found that weak performers used more muscles than strong performers and stated that to improve pushup performance you need to improve both strength and skill of execution.

In reviewing the literature on calisthenics and weight training, there is no clear indication as to which method of exercising is better. Calisthenics have an advantage of being simple to perform, suitable for mass groups, versatile, and inexpensive. Weight training is favored for its motivational appeal and the ability to significantly increase the intensity of the workout.

Thompson found that for low fitness individuals calisthenic training showed better results than weight training. Wieman, in a study of the Army's physical training program in the Second World War, also found that calisthenics were effective in improving physical condition.

In weight training studies, Chui found that contrary to the belief at that time weight training significantly improved speed and jumping ability. Shepard found that low fitness individuals showed greater improvement with weight training than individuals who were in good physical condition. Berger found the optimum number of repetitions per set to be from three to nine.

There appears to be no consensus of opinion as to whether a calisthenic or a weight training program is more effective in building strength and muscular endurance. Likewise there is no agreement on the optimum frequency of each exercise program to provide the greatest improvement in muscular strength and endurance.

CHAPTER III

METHODS AND PROCEDURES

This chapter includes a description of the procedures employed in this study comparing calisthenics and weight training used in the development of strength and muscular endurance among Army personnel. The chapter is divided into the following sections: a) pilot studies, b) selection of the subjects, c) equating of the groups, d) training period, e) test measurements, and f) test results.

Pilot Studies

The exercise used to measure upper body strength and muscular endurance in the Army is the pushup. For the purpose of this study, a measure of equating the amount of strength needed for the performance of a pushup and the amount of weight needed to measure muscular endurance using the bench press exercise had to be determined. To find that weight, a pilot study was conducted on March 28, 1982, using 20 male college students at The Pennsylvania State University.

The test consisted of doing one pushup with the subject's hands resting on an electronic scale and the feet elevated so they were on the same level as the hands. The writer hypothesized that the amount of force exerted by an individual when he lifted himself from the ground into a full pushup with the arms fully extended and locked would represent the percentage of weight that should be measured for endurance testing on the bench press exercise. The results of this study appear in Appendix A, Table 14.

The results of this pilot study showed that the force exerted in doing a pushup varied from an average of 65.0 percent of body weight when the individual was supporting himself at the lowest point to an average of 82.0 percent of body weight that was obtained at a point in the movement of the body into the up-position of the pushup. Therefore, it was decided that the value of 75 percent of the maximum weight an individual could lift in the bench press exercise for only one repetition would be used in this study.

The 75 percent maximum bench press weight was then used in another pilot study involving 10 male college students at The Pennsylvania State University on March 30, 1982. This study was to determine if the 75 percent of the maximum weight a subject could lift on the bench press exercise was acceptable for endurance testing. If the percentage was too high, a subject would be able to do too few repetitions and the test would not be a measure of muscular endurance as much as it would be of strength. If the value was too low, the subject might become bored from too many repetitions of the exercise and quit before he did the maximum number of repetitions possible.

In this pilot study the subjects were tested on the bench press exercise using a standard weight lifting bench and Olympic standard weights. The bench press exercise was performed in the following manner. The subject laid supine on the bench with his head, upper back, and buttocks in contact with the bench; the knees were flexed at a 90-degree angle; and the feet were resting flat on the floor. The subject removed the bar from the steel supports alone or with the help of an assistant, if necessary. He held it at arm's length, then

lowered it to his chest by flexing the elbows. When the weight touched the subject's chest, he immediately pushed the barbell upward until the arms were fully extended, thereby completing one repetition.

The subjects were first tested as to the maximum weight they could lift for one repetition, called the subject's 1RM weight. This was done by several trials with the subject starting at a weight he felt he could lift and adjusting the weight by adding or subtracting weight in five-pound increments until his 1RM weight was found. There was a one-minute rest between each attempt to allow the muscles time to recover. An average of three attempts per individual were needed to find the 1RM weight.

After the 1RM weight was found for each subject, the weight on the bar was set at 75 percent of the maximum 1RM weight for each individual and each subject tried to do as many repetitions of the exercise as he could. The results of this pilot study are contained in Appendix B, Table 15. The results of the test showed that the subjects did a high of 15 repetitions with 75 percent of their maximum 1RM weight and a low of six repetitions. The average was 9.2 repetitions. This appeared to be an acceptable mean percentage to measure muscular endurance, and 75 percent was therefore used in determining the weight for the bench press endurance exercise.

Subjects

The subjects for this study were 214 Army Initial Entry Training soldiers in the 18th Battalion, 4th Training Brigade at Fort Knox,

Kentucky. The four experimental groups were assigned to B Company and the current Army training group was assigned to D Company. All soldiers started basic training on August 23 or 24, 1982. They varied in age from 17 to 29 years with an average of 19 years. These subjects did not volunteer for this study but were assigned to the company by standard Army assignment procedures. They were assigned by Army personnel who had no knowledge that the unit was going to be involved in an experimental investigation. As such, they had no reason to change their assignment procedures or bias the results of the study in any way. The soldiers were also assigned to the individual groups for the experiment by Army assignment personnel. A standard Initial Entry Training unit is the platoon, composed of 50 men; each experimental group was a separate platoon. This writer believed the soldiers in the study were representative of the male recruits who are currently enlisting in the Army.

The Training Program and Groups

The sample was divided into five groups for the purpose of this study. The training period for each of the five groups was seven weeks, which is the length of Initial Entry Training. The training programs for each of the five groups are summarized in Table 1.

Group I, the current Army physical training program group, acted as the control for this investigation. They engaged in the physical conditioning program currently used by the Army as outlined in Appendix C. The program consisted of one hour of physical training done six days each week. In addition, one exercise of pullups was done before each noon and evening meal. These were the only formal upper

TABLE 1. Outline of the training programs for the five experimental groups.

GROUP	DAY						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Group I	Normal Army PT[a]	Same as Monday	Same as Monday	Same as Monday	Same as Monday	Same as Monday	No training
Group II	Normal Army PT plus calisthenics[b]	Normal Army PT	Same as Monday	Normal Army PT	Same as Monday	Normal Army PT	No training
Group III	Normal Army PT plus weight training[c]	Normal Army PT	Same as Monday	Normal Army PT	Same as Monday	Normal Army PT	No training
Group IV	Normal Army PT plus calisthenics	Same as Monday	Same as Monday	Same as Monday	Same as Monday	Same as Monday	No training
Group V	Normal Army PT plus weight training	Same as Monday	Same as Monday	Same as Monday	Same as Monday	Same as Monday	No training

[a]PT is an abbreviation for physical training.

[b]The calisthenics included five pushup exercises and five other exercises.

[c]The weight training included five sets of two different exercises.

body building exercises done throughout the day. The soldiers did engage in all other training, such as road marches with field equipment, which may have helped improve upper body strength.

Group II was the alternate day calisthenic training group. They were subjected to the same physical training program as Group I. In addition, they engaged in a 30-minute calisthenic training program at the end of the training day on Mondays, Wednesdays, and Fridays. This program consisted of 10 exercises.

Group III was the alternate day weight training group. They did the same physical training program as Group I. In addition, they engaged in a 30-minute, 10-exercise weight training program primarily designed for the development of the muscles used in the pushup and bench press exercises. They did this training on Mondays, Wednesdays, and Fridays during the seven-week training period.

Group IV was the daily calisthenic group. They did the same training as Groups I and II with the exception that they did the 10-exercise, 30-minute calisthenic training program six days a week, Monday through Saturday.

Group V was the daily weight training group. They did the same training program as Groups I and II with the exception that they did the 10-exercise, 30-minute weight training program six days a week, Monday through Saturday.

Testing Procedures

Description of the Tests

The Army Physical Fitness Test consists of three events: the pushup, the situp, and a two-mile timed run. For the purpose of this study, the pushup was the primary concern, and therefore is the only part of the test discussed.

The pushup test began with the subject in the front leaning rest position. The back of the subject was straight throughout the exercise. The pushup was done by the subject lowering his body until the top of the upper arms, shoulders, and the lower back were in the same horizontal plane, then he returned to the starting position. The scorer counted the number of correct repetitions. If the body was not straight, if the subject did not go down until the upper arms and shoulders were parallel with the ground, or if the elbows were not completely extended when the subject returned to the starting position, the tester told the subject and the repetition did not count. The subject had two minutes to do as many repetitions as possible. He could not rest in any position other than the starting position (up position). He was not allowed to flex his back between repetitions. All subjects were briefed on the test and practiced the correct procedures during normal training periods.

The Bench Press Test

In addition to the pushup test, two types of bench press tests were conducted. The first test was to determine the maximum amount of weight the subject could bench press for one repetition, called

his 1RM weight. The second test was a test of relative muscular endurance of the upper body. It was conducted as a bench press exercise in which the weight was 75 percent of the subject's 1RM weight as determined in the first bench press test.

The bench press test was performed in the following manner. The subject laid supine on the bench with his head, upper back, and buttocks resting on the bench, the knees flexed at 90 degrees, and the feet flat on the floor. The subject removed the bar from the steel supports alone or with the help of an assistant, if necessary. He held the barbell at arm's length and then lowered it to touch his chest by flexing his elbows. When the weight touched his chest, the subject immediately pushed the barbell upward until his arms were fully extended. That constituted one repetition of the exercise.

The first bench press test was to find the maximum weight a subject could lift for one repetition. The approximate weight was known from practice lifts done for two days prior to the test. This was done so the exercise would not be new to the subjects when they were first tested. From this approximate weight, the test administrator simply added or subtracted weights in five-pound increments until the 1RM weight was found. Each subject took an average of three trials to find the 1RM weight. There was a 30-second rest interval between each trial to allow the muscles time to recover.

The second bench press test began after all subjects completed the first test. This was the endurance test in which each subject did as many repetitions as possible using 75 percent of his 1RM

weight established in the first test. There was at least a 30-minute rest between both tests.

Personnel Administering the Tests

The pushup pre-test and post-test were administered to all subjects by the Testing and Evaluation Committee at Fort Knox. This committee normally conducts all formal testing of Army personnel at Fort Knox. For the purpose of this investigation, they agreed to conduct the pre-test as well as the post-test.

The bench press tests were conducted by the training cadre of the experimental units under the supervision of the writer. All personnel administering the tests were trained on the proper procedures prior to the tests.

Administration of the Tests

The pushup pre-test was administered on the third day of training. The subjects were divided into eight equal groups and assigned to a tester. Each tester had six or seven subjects from each training group.

The bench press test was administered on the fourth day of training to all subjects. The subjects were broken down into 10 groups. They executed the 1RM strength test first. After all subjects had completed the 1RM test, they began the relative muscular endurance bench press test. The post-tests for each exercise were conducted exactly like the pre-tests. The pushup post-test was conducted on the 42nd day of training, and the bench press post-tests were conducted on the 43rd day of training.

Training of the Drill Sergeants

The training instructors for this experiment were 10 Army drill sergeants, two assigned to each group. They were responsible for all training of the subjects. The writer conducted a training period three days prior to the start of the experimental period. The experimental protocol, frequency of exercise, and the method of doing the exercises were covered in detail. All the drill sergeants involved in the training of the subjects were familiar with the exercises before the start of the experiment.

The writer or the commander of the experimental unit was present for all training and testing. This was to insure that the specific exercise protocol was followed and that all data were properly recorded.

Description of the Training Periods

The daily training period for all groups consisted of a one-hour period made up of 15 calisthenic exercises and a platoon run from one to five miles, depending on the time in the training cycle. In the calisthenic period, four pushup exercises and two pullup exercises were done by all groups. This calisthenic period was scheduled six days a week for all groups.

The calisthenic training groups also engaged in a 30-minute exercise period each evening (Group IV) or every other evening (Group II). This training consisted of ten calisthenic exercises, five of which were pushups. The sequence was as follows:

a) Stretching for one minute

b) Pushups: 20 repetitions

c) Side straddle hops

d) Pushups: 20 repetitions

e) Trunk twisters

f) Pushups: 15 repetitions

g) Deep knee bends

h) Pushups: 15 repetitions

i) Situps

j) Pushups: 10 repetitions

k) Stretching for two minutes

The program was designed to stress the muscles used in the pushup and bench press exercises and to exercise them to exhaustion. The pushup was done in cadence. Individuals who could not keep pace with the group during any part of the training were told to continue exercising at their own pace. When all the individuals in the group were able to perform all the exercises, five repetitions were added to each set of pushup exercises.

The Weight Training Groups

Both weight training groups engaged in the same training as the control group during the normal physical training periods. In addition, each evening Group V and every other evening Group III performed a 30-minute weight training program consisting of two exercises: the bench press exercise and the overhead press exercise. Five sets of each exercise were performed each exercise period for a total of 10 exercises during the period. The number of repetitions of each set

varied from six to ten, depending on how many each individual could do at that time. When an individual was able to do ten repetitions in at least three of the five sets of an exercise, he increased the weight lifted in the exercises by 10 pounds. The exercises were chosen because they required the use of the triceps muscles of the arms, anterior shoulder muscles, and the chest muscles. These are the same muscles used in the criterion tests--the pushup and the bench press exercises.

Description of the Exercises

This section contains a description of the four exercises used in this study. The two weight training groups occasionally did the pushup and pullup exercises, and the three non-weight training groups occasionally practiced the two weight training exercises in order to insure that differences in performance on each test were not due to the novelty of the exercise.

Pushup

The pushup was accomplished in the front leaning rest position. The arms and back were straight. The subject lowered himself on the count of "one" until the top of the upper arms, shoulders, and lower back were in the same horizontal plane and parallel to the ground. On the count of "two," the body was raised into the starting position. This completed one repetition of the exercise.

Pullup

The pullup was done by having the subject grasp a horizontal bar nine feet above the ground with his palms facing away from him and

his thumbs underneath the bar. His body was fully extended in a hanging position with the arms straight and the feet not touching the ground. He pulled his body upward until his chin was above the bar, then returned to the starting position. This constituted one repetition. Each subject did as many pullups as he could.

Bench Press

The bench press was performed in the following manner. The subject, while lying on his back on a standard weight lifting bench, removed the bar from the steel supports above his head and held it at arm's length with his elbows locked. He then lowered the weight by flexing his elbows. The weight was lowered in this manner until it touched his chest, and he then immediately pushed the weight back to the starting position. This was one repetition.

Overhead Press

The overhead press was performed with the feet spread about shoulder width apart. The bar which rested on the floor was grasped with the overhand grip about shoulder width apart. The weight was picked up from the floor and brought to shoulder height with the hands extended at the wrists and the elbows completely flexed. This was the starting position. From this position, the weight was pushed overhead until the arms were fully extended. The weight was then lowered back to shoulder height. This completed one repetition.

Treatment of the Data

The data collected during this investigation were statistically analyzed to compare: a) the equivalence of the groups at the start of training, and b) the differences, if any, in the mean strength and endurance scores of the training groups at the end of the seven-week training period. A two-way analysis of variance with repeated measures on one factor was employed to determine if there were any significant differences among mean performances of the five groups. The interaction of tests with groups was also considered in this two-way analysis of variance. If the simple effects of significant interactions were tested, Duncan's Multiple Range Test was used to determine if there were any significant differences between the training groups. A significance level of .05 was used for all tests.

The relationships among performances on the three tests were determined for each experimental group using Pearson Product-Moment Correlation coefficients, and these were combined to obtain a correlation coefficient for all five groups. This was done to determine if performances on one test related to performances on another.

CHAPTER IV

ANALYSIS OF DATA

This chapter presents an analysis of the data collected during this investigation. It is divided into the following sections: a) an analysis of the differences among the training groups on the pushup test, b) an analysis of the differences among the groups on the 1RM bench press test, c) an analysis of the differences among groups on the 75 percent of 1RM bench press test, d) the relationships among gains in performances on the three tests, and e) a discussion of the findings.

Analysis of Differences Among Groups on the Pushup Test

A two-factor (training by test) analysis of variance with repeated measures on one factor, tests, yielded an F-ratio of 1.15 (Table 2) for the differences in mean pushup performances among the five training groups. Since the F-ratio was not statistically significant ($p>.05$) on the average all five training groups performed about the same on the three tests administered over the seven-week training period.

The interaction effect of training group by test yielded an F-ratio of 1.61 (Table 2) which also was not statistically significant. This meant the pattern of change from the pre- to mid-, mid- to post-test was similar for all five training groups. Since there were no significant differences between the groups at the start of the

TABLE 2. Summary of analysis of variance among mean scores for training groups and pushup tests.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio
Between Subjects				
Training Groups	4	950.23	237.56	1.15
Error	209	43341.01	207.37	
Within Subjects				
Pushup Tests	2	41667.95	20833.97	711.82*
Tests by Groups	8	375.80	46.97	1.61
Error	418	12234.25	29.27	
Total	641	99519.47		

*Significant at the .05 level.

investigation, it can be concluded that all groups made similar gains in pushup performance over the seven-week period.

The analysis of variance of performance over the pre-, mid-, and post-tests yielded an F-ratio of 711.82 (Table 2, page 46) which was statistically significant. This meant that the mean pushup performance on at least one test was statistically different than the other two. The means and standard deviations for the three tests for each experimental group are shown in Table 3. Using Duncan's Multiple Range Test of differences between the pre-, mid-, and post-test means, it was found that the mean number of pushups performed by all subjects in the investigation on the mid-test was significantly greater than on the pre-test and that the mean performance on the post-test was significantly greater than on the mid-test (Table 4). From these results, it was concluded that improvement in pushup performance was made over both the first and second halves of the seven-week training period.

Analysis of Differences Among Groups on the 1RM Bench Press Test

A two-factor (training by test) analysis of variance with repeated measures on one factor, tests, showed an F-ratio of .88 (Table 5) among the five training groups on the mean differences in performances on the 1RM bench press pre-, mid-, and post-tests.

An analysis of variance of the interaction of the training group by test provided an F-ratio of 3.05 (Table 5) which was significant at the .05 level. In order to determine the reason for the significant interaction, an analysis of the simple effects between the training groups and tests was conducted. An analysis of the 1RM pre-test

TABLE 3. Means and standard deviations for the pushup tests.

Group	Pre-test		Mid-test		Post-test	
	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s
Current Army Program (N=42)	22.94	14.54	31.52	15.38	39.90	17.02
Alternate Day Calisthenics (N=43)	22.81	14.97	34.26	16.63	41.23	18.12
Alternate Day Weight Training (N=44)	22.73	13.21	36.80	13.71	44.41	13.91
Daily Calisthenics (N=43)	23.65	14.15	35.23	14.54	44.28	14.97
Daily Weight Training (N=42)	23.07	12.03	34.93	11.09	42.88	13.23
Means for All Subjects	23.04	13.78	34.55	14.27	42.54	15.45

TABLE 4. Results of Duncan's test of differences between the pre-, mid-, and post-test scores on the pushup tests.

Test	Means	Mid-	Post-
Pre-	23.04	11.51*	19.50*
Mid-	34.55		7.99*
Post-	42.54		

*Significant at the .05 level.

TABLE 5. Summary of analysis of variance among mean scores for training groups and 1RM bench press tests.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio
Between Subjects				
Training Groups	4	3502.70	875.68	0.88
Error	209	207339.90	992.06	
Within Subjects				
Bench Press Tests	2	135808.60	67904.28	627.62*
Tests x Groups	8	2636.12	329.52	3.05*
Error	418	45224.65	108.19	
Total	641	394511.97		

*Significant at the .05 level.

results showed an F-ratio of .35 (Table 6) which was not statistically significant, so it can be concluded that the groups were equal at the start of the training. An analysis of the mid-test results showed an F-ratio of .88 (Table 6) which also was not statistically significant ($p>.05$). An analysis of the post-test results showed an F-ratio of 2.50 (Table 6) which was statistically significant; therefore, it can be concluded that the significant group by test interaction was due to at least one of the training groups performing differently on the 1RM bench press post-test. Using Duncan's Multiple Range Test, the results showed that both weight training groups scored significantly better than the alternate day calisthenic group but not significantly better than the current Army training group or than the daily calisthenic group (Table 7). From these results, it can be concluded that weight training improves performance better than alternate day calisthenics over a seven-week training period when measured by the 1RM bench press. The means and standard deviations for each of the five experimental groups on the three 1RM bench press tests are shown in Table 8.

Analysis of Differences Among Groups on the 75 Percent of 1RM Bench Press Test

A two-factor (training by test) analysis of variance with repeated measures on one factor, tests, yielded an F-ratio of 1.26 (Table 9) for the differences in mean 75 percent of 1RM bench press performances among the five training groups. Since this F-ratio was not significant ($p>.05$) and since the differences in the average number of repetitions done by each training group was not statistically significant (Table 9), it could be concluded that when the scores on the three

TABLE 6. Simple effects analysis of the group by test interaction on the 1RM bench press test.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio
Pre-test	4	570	142.50	0.35
Mid-test	4	1419	352.75	0.88
Post-test	4	4028	1007.00	2.50*
Error			402.81	

*Significant at the .05 level.

TABLE 7. Results of Duncan's test of differences between the 1RM bench press post-test means for the five training groups.

Group	Means	Control	Daily Calisthenics	Alternate Day Weight Training	Daily Weight Training
Alternate Day Calisthenics	170.81	1.93	2.10	9.64*	10.62*
Current Army Program	172.74		0.17	7.71	8.69
Daily Calisthenics	172.91			7.54	8.52
Alternate Day Weight Training	180.45				0.98
Daily Weight Training	181.43				

*Significant at the .05 level.

TABLE 8. Means and standard deviations for the 1RM bench press tests.

Group	Pre-test		Mid-test		Post-test	
	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s
Current Army Program (N=42)	140.83	34.68	158.69	26.29	172.74	38.23
Alternate Day Calisthenics (N=43)	138.26	31.01	155.23	31.69	170.81	33.21
Alternate Day Weight Training (N=44)	141.02	30.69	162.61	32.65	180.45	33.13
Daily Calisthenics (N=43)	142.28	27.14	159.77	28.04	172.91	28.53
Daily Weight Training (N=42)	138.10	26.62	161.79	28.16	181.43	28.97
Means for All Subjects	140.10	30.03	159.62	31.27	175.67	32.41

TABLE 9. Summary of analysis of variance among mean scores for training groups and the 75 percent of 1RM bench press tests.

Source of Variation	*Degrees of* Freedom	*Sum of* Squares	*Mean* Square	F-ratio
Between Subject				
Training Group	4	2822.73	705.68	1.26
Error	209	117085.90	560.22	
Within Subjects				
Bench Press Tests	2	77510.98	38755.49	574.48*
Tests x Groups	8	1223.33	152.92	2.27*
Error	418	28199.02	67.46	
Total	641	226841.96		

*Significant at the .05 level.

tests were averaged the mean performances of all five groups were similar. The means and standard deviations for each of the five experimental groups on the three tests are shown in Table 10.

The analysis of variance of the interaction of the training group by tests showed an F-ratio of 2.27 (Table 9, page 53) which was statistically significant. These results indicated that at least one group performed significantly different than the other groups on at least one of the tests. In order to determine the differences among the groups on the individual tests, the simple effects of each group's performance on the pre-, mid-, and post-tests were analyzed. The analysis revealed no significant differences on the pre-test which showed that the groups had statistically similar performances at the start of training (Table 11). The results of the mid-test analysis were also not statistically significant (Table 11) which indicated no significant differences among the groups on the mid-test. There was a significant difference between the five training groups on the 75 percent of 1RM bench press for the post-test with an F-ratio of 2.23 (Table 11). This indicated that the significant difference on the training group by test interaction was due to at least one group performing differently on the 75 percent of 1RM post-test. Using Duncan's Multiple Range Test, the results showed that only the daily weight training group scored significantly better than the alternate day calisthenics group on the 75 percent of 1RM bench press post-test (Table 12). From these results, it can be concluded that daily weight training was significantly better than alternate day calisthenics over a seven-week training period when measured by the 75 percent of 1RM bench press test.

TABLE 10. Means and standard deviations for the 75 percent of 1RM bench press tests.

Group	Pre-test		Mid-test		Post-test	
	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s
Current Army Program (N=42)	105.95	24.71	117.38	25.85	130.12	27.02
Repetitions	8.02		7.81		7.86	
Alternate Day Calisthenics (N=43)	103.14	22.13	116.51	22.91	128.26	23.06
Repetitions	8.02		7.70		7.47	
Alternate Day Weight Training (N=44)	107.50	20.35	122.38	21.03	135.23	22.71
Repetiions	7.93		8.02		7.64	
Daily Calisthenics (N=43)	106.28	25.05	119.42	25.36	131.46	22.97
Repetitions	7.63		8.23		8.02	
Daily Weight Training (N=42)	103.69	22.14	122.86	22.63	136.43	23.80
Repetitions	7.50		7.81		8.21	
Means for All Subjects	105.31	22.88	119.55	23.62	132.23	23.91

TABLE 11. Simple effects analysis of the group by test interaction on the 75 percent of 1RM bench press test.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio
Pre-test	4	323	80.75	0.35
Mid-test	4	1375	343.75	1.48
Post-test	4	2060	515.00	2.23*
Error			231.71	

*Significant at the .05 level.

TABLE 12. Results of Duncan's test of differences between the 75 percent of 1RM bench press post-test means for the five training groups.

Group	Means	Control	Daily Calisthenics	Alternate Day Weight Training	Daily Weight Train-ing
Alternate Day Calisthenics	128.26	1.86	3.20	6.97	8.17*
Current Army Program	130.12		1.34	5.11	6.31
Daily Calisthenics	131.46			3.77	4.97
Alternate Day Weight Training	135.23				1.20
Daily Weight Training	136.43				

*Significant at the .05 level.

Relationships Among Performances on the Three Tests

Concerning the three tests used in this study (the pushup, the 1RM bench press, and the 75 percent of 1RM bench press), it was hypothesized by this writer that the 1RM bench press was a test that measured strength and the 75 percent of 1RM bench press was a test that measured strength and endurance. Further, it was assumed that the pushup measured strength and muscular endurance.

In order to investigate these assumptions, the relationships between the results of the three tests were obtained by calculating Pearson Product-Moment correlation coefficients. Correlations for scores in each training group were found between: a) the pushup and 1RM bench press post-test results, b) the 1RM bench press post-test and the strength-endurance index computed from the 75 percent of 1RM bench press results, c) the change in performance from pre-test to post-test in pushups and 1RM bench press, and d) change in pushup performance with the strength-endurance index. Table 13 shows the results of these correlations. The correlations for each of the five groups were combined to obtain a correlation for all subjects using a Z-transformation.[40]

The correlation of the pushup with the 1RM bench press was found to be r=.378 (Table 13). The low positive correlation agrees with the findings of Clarke[41] who stated that the pushup correlated moderately

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[40]Chauncey A. Morehouse and G. Alan Stull, Statistical Principles and Procedures with Applications for Physical Education (Philadelphia: Lea and Febiger, 1975), pp. 204-206.

[41]Clarke, page 19, this manuscript.

TABLE 13. Relationships among scores and gains in scores on the criterion variables.

Tests	Current Army Program	Alternate Day Calisthenics	Alternate Day Weights	Daily Calisthenics	Daily Weights	Combined
	df[a] = 40	41	42	41	40	212
Pushup vs. 1RM Bench Press	r = .350*	.410*	.350*	.360*	.330*	.378*
1RM Bench Press vs. Strength-Endurance Index	r = .317*	.240	.292	.315*	.311*	.291*
Pushups vs. 1RM Bench Press (Gain in Scores)	r = .004	.102	.113	.086	.057	.067
Pushups vs. Strength-Endurance Index (Improvement in Scores)	r = -.058	-.049	.015	.017	.023	-.010

[a]df = degrees of freedom for correlation coefficients (df = n - 2).

*Significant at .05 level of probability.

well with strength (r=.466) when arm length of the individual was not included in the calculations.

The correlation of the 1RM bench press test with the strength-endurance index computed from the 75 percent of 1RM bench press test was r=.291 (Table 13, page 58). The results of this correlation are not easily explained. Two possible explanations may be that: a) there is a small positive correlation between the 1RM bench press and the 75 percent of 1RM bench press, or b) the strength-endurance index this writer used in the study was not valid.

The correlation of improvement in pushup performance and improvement in 1RM bench press performance was r=.067 (Table 13, page 58). this correlation was not statistically significant which meant that increases in pushup performance were not necessarily accompanied by improvements in bench press performance. In fact, there was almost a complete lack of correlation between the two.

The third correlation calculated was between pushup improvement and improvement in the 75 percent of 1RM bench press based on the strength-endurance index defined in Chapter I. This correlation was -.010 which was even less than the correlation between pushup improvement and the 1RM bench press improvement. This showed that the 75 percent of 1RM bench press test was no better a predictor of pushup performance than the 1RM bench press.

The lack of correlation between bench press and pushup improvement seemed to suggest two points. First, the pushup, as stated by Hinson,[42] is a complex exercise, the requirements for which are not easily

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[42]Hinson, page 21, this manuscript.

duplicated by another exercise. Secondly, it appears that these results supported Berger's[43] findings that exercise is specific because success in improving pushup performance did not appear to correlate with improvements in bench press performance.

Discussion

The results of the analyses revealed that all five training groups improved significantly from the pushup pre-test to the post-test in this seven-week investigation, but there were no significant differences in improvement among the five training groups. These findings seem to support the findings of Noble and McCraw[44] that any exercise program, whether it be calisthenic or specific weight training, will increase strength and muscular endurance if done frequently and with sufficient intensity.

The findings seem to differ from those of Thompson[45] who in a similar study of the effect of weight training and calisthenics on low fitness college males concluded that calisthenic training was superior to weight training in improving strength and muscular endurance. Perhaps this difference between the two results can be explained by the fact that the recruits in this study ranged from excellent to poor physical condition at the start of the training, while Thompson's study only involved low fitness individuals.

Despite the lack of significance, the graph of the group means

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[43] Berger, page 9, this manuscript.

[44] Noble and McCraw, page 12, this manuscript.

[45] Thompson, page 24, this manuscript.

for pushup performance from the pre-test to the post-test for the five training groups showed that the two calisthenic and the two weight training groups had slightly steeper slopes for mean pushup performances than the current Army training program group (Figure 1). It is possible that if the experiment had been continued for a longer period of time some of the groups may have shown significantly better performances when compared with the current Army program training group.

The results of the bench press test showed that both weight training groups scored significantly better than the alternate day calisthenic group on the 1RM bench press post-test, and the daily weight training group scored significantly better than the alternate day calisthenic group on the 75 percent of 1RM bench press post-test. The graphs of the 1RM bench press and 75 percent of 1RM bench press (Figures 2 and 3) both showed that the weight training groups had steeper slopes than the non-weight training groups. This meant that the rates of improvement on the bench press tests were greater for the weight training groups than they were for the three non-weight training groups. It is possible that if the training program was longer than seven weeks, the two weight training groups would have scored significantly better than all non-weight training groups. These results clearly support Berger's[46] findings that training is specific; i.e., the weight training groups which trained with weights did better on the tests using weights than the non-weight training groups.

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[46]Berger, page 9, this manuscript.

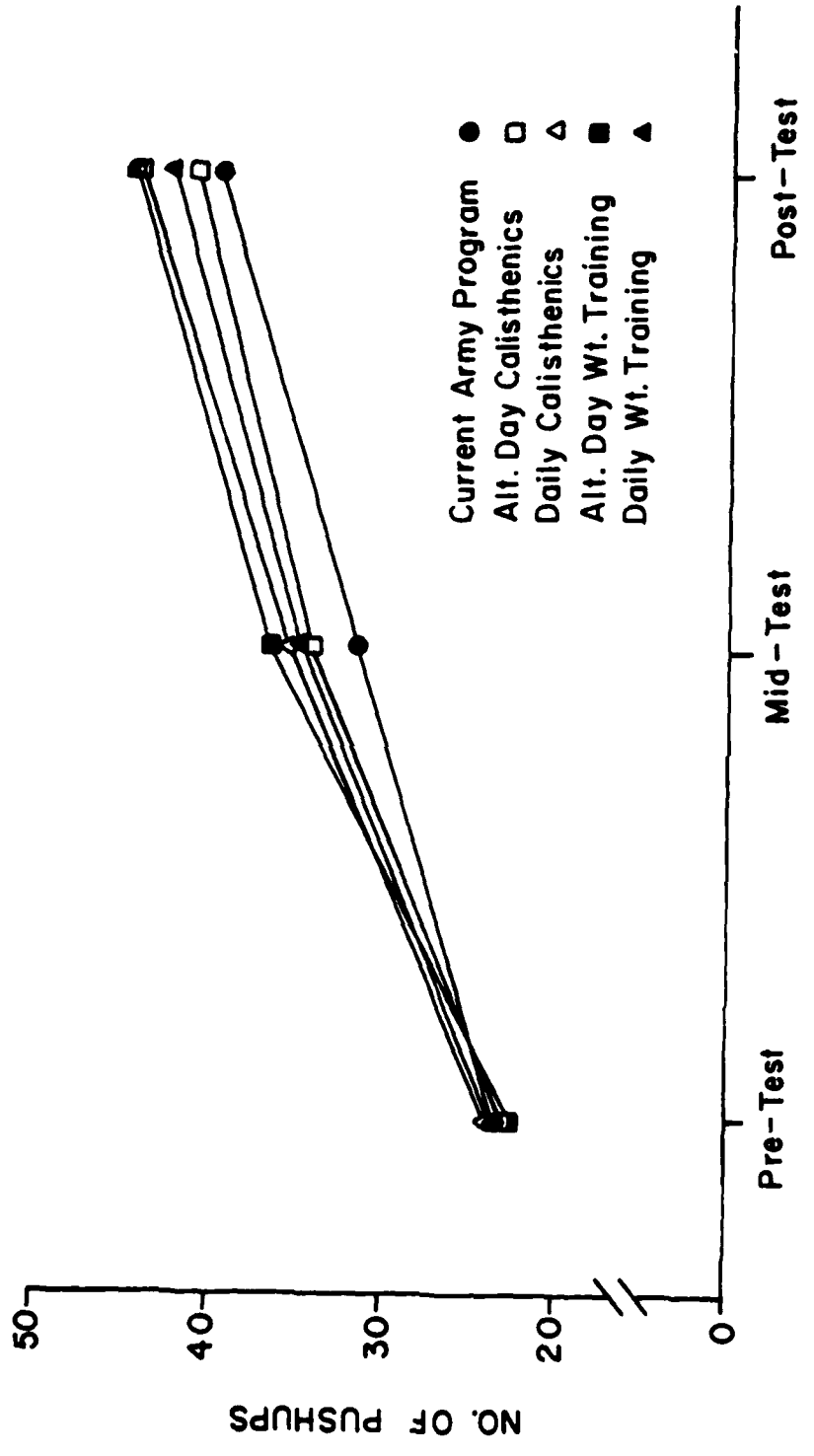

FIGURE 1. Mean performances of the five training groups in the pushup.

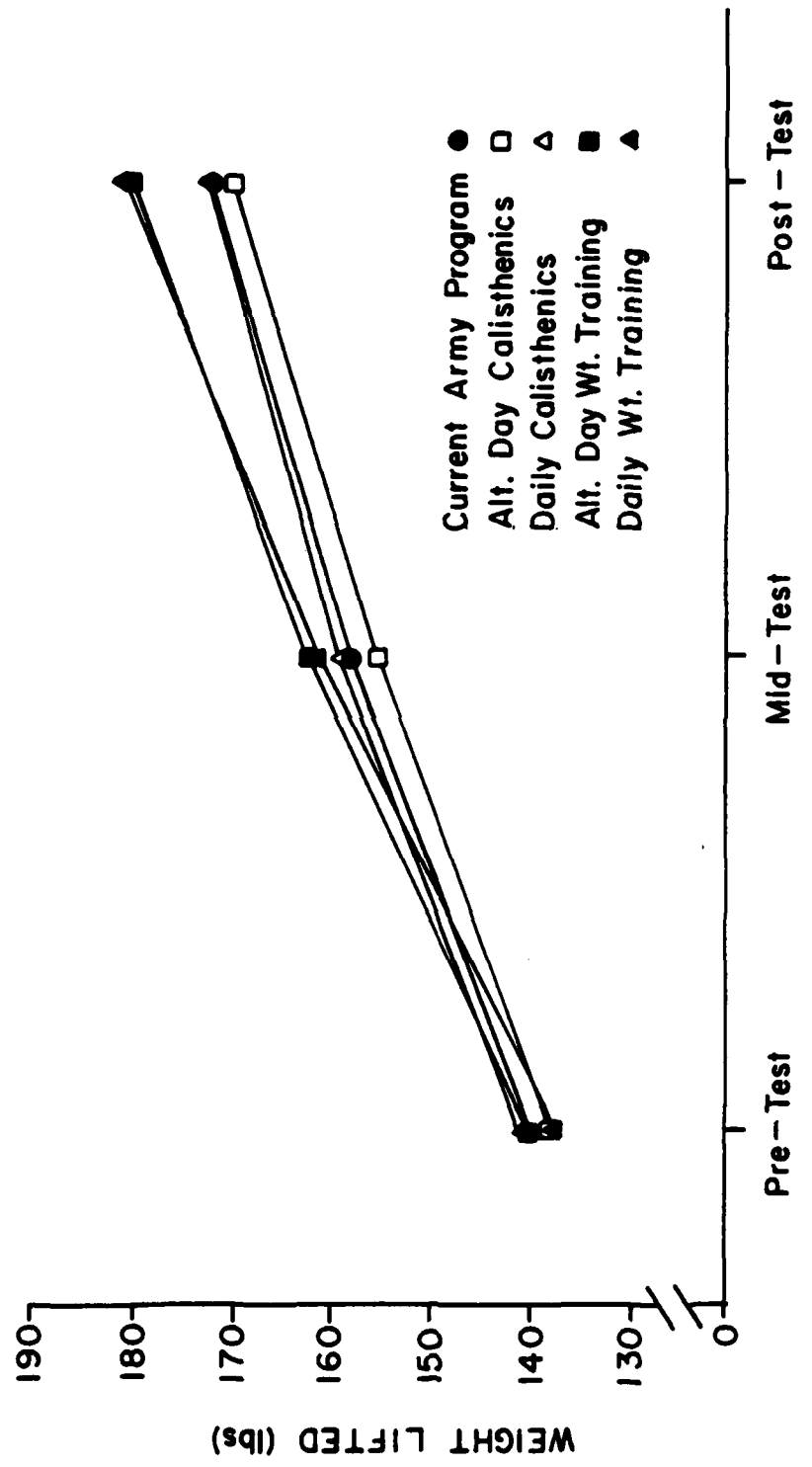

FIGURE 2. Mean performances of the five training groups on the 1RM bench press.

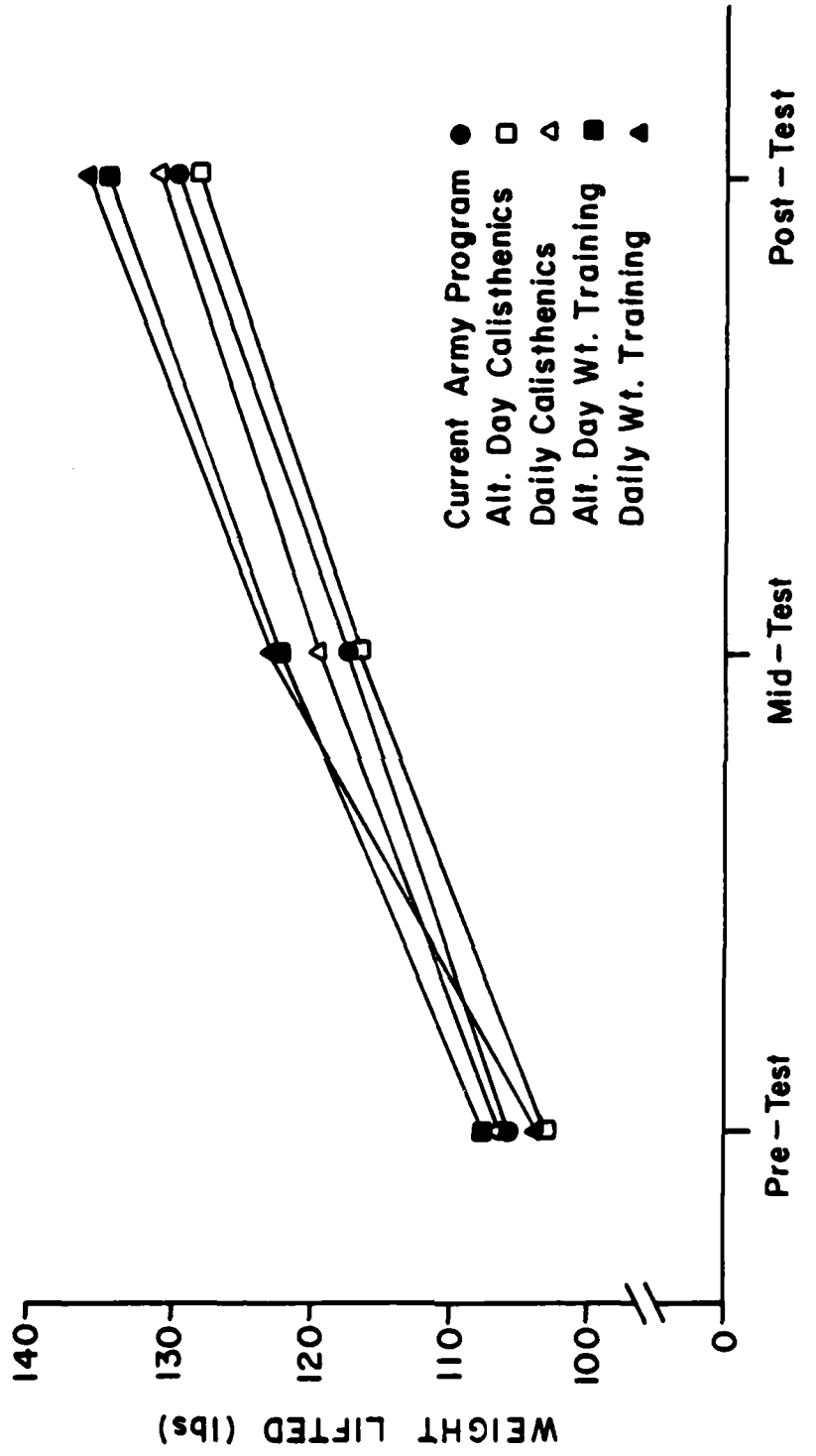

FIGURE 3. Mean performances of the five training groups on the 75 percent of 1RM bench press.

In regard to the effects of the frequency of training, the results of this study are mixed. The results appear to contradict the findings of Sitler[47] who found that weight training was better every other day rather than daily. It also contradicted findings of McGlynn[48] that twice-a-day intensive exercise is less effective than daily or every other day training. Both daily training groups participated in the current Army training program in the morning and their supplemental training program at night with no apparent difference in mean performances over the seven-week training period on the pushup test. Further, the daily weight training group scored the best of all the groups on the bench press tests, and the daily calisthenic training group scored better than all but the alternate day weight training group on the pushup test. Although the scores were not significantly different, the scores of the two calisthenic training groups and the two weight training groups on the pushup post-test were closer to each other than to the score of the current Army training program group. This showed that the additional training was not detrimental.

Westcott's[49] findings that strength gains were the same regardless of the frequency of exercise as long as the number of repetitions was constant appears to have been supported by the findings of this investigation. Unlike Westcott's study, the amount of training was not held constant, so the daily training groups did more exercises than the alternate day groups. In this regard, it did not appear in this

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[47]Sitler, page 17, this manuscript.

[48]McGlynn, page 16, this manuscript.

[49]Westcott, page 27, this manuscript.

investigation that there was a significant advantage in doing additional exercises daily rather than every other day since differences among the groups were not statistically significant on the pushup post-test.

The results of the correlations between pushups and the bench press showed that as Clarke[50] stated the pushup seemed to be a low postive indicator of strength. But improvement in pushup performance was found in this study to have no correlation with improvement in bench press performance. Also, it appeared that the 75 percent of 1RM bench press is no better for measuring strength and endurance than the 1RM bench press based on the lack of correlation with pushup improvement.

It seemed that while the current United States Army physical training program for Initial Entry Training for building upper body strength is sound, additional improvement can be gained from the addition of a 30-minute calisthenic or weight training program done as frequently as three times a week. It also appears that both weight training and calisthenics bring about similar improvement in pushup performance when used over a seven-week training period.

Based on these findings, local commanders can tailor their additional physical training to their own needs and dispel the apprehension that twice a day physical training will lead to excessive fatigue and impair physical performance rather than help it.

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[50]Clarke, page 19, this manuscript.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purposes of this study were to compare the effects of: a) calisthenic exercises and weight training in the development of upper body strength and muscular endurance as measured by the bench press test and the pushup test, and b) these programs when done every day or every other day on the improvement of upper body strength and muscular endurance of United States Army recruits.

Summary

All the participants in this investigation were Initial Entry Training soldiers assigned to Fort Knox, Kentucky, by standard Army assignment procedures. The subjects trained seven weeks which is the length of Initial Entry Training in the Army. All groups trained using the standard Army physical training program currently in use in Initial Entry Training (Appendix C). The first group, (N=42), trained solely using this program. The second group, (N=43), the alternate day calisthenic group, did an additional 10-exercise calisthenic program every Monday, Wednesday, and Friday during the training period. The third group, (N=44), the alternate day weight training group, did a 10-exercise weight training program every Monday, Wednesday, and Friday. The fourth training group, (N=43), was the daily calisthenic training group. They did the same training program as Group II except they performed calisthenics daily from Monday through

Saturday during the seven-week training period. The fifth group, (N=42), was the daily weight training group, and they did the same training as Group III except they weight-trained daily, Monday through Saturday.

The pushup test, the one-repetition maximum bench press test, and the 75 percent of one repetition maximum bench press test were used to evaluate mean differences in strength and muscular endurance. The tests were administered to all subjects before and after the training period and approximately in the middle of the seven-week training period. The test scores were subjected to a two-factor analysis of variance with repeated measures on one factor (Lindquist Type I Design). Within-group and between-group comparisons were used to determine if there were significant differences among the tests, groups, or the test by group interactions. The simple effects of the test by group interaction on the post-tests were analyzed using a one-way analysis of variance and Duncan's Multiple Range Test when the interaction effect was statistically significant.

Findings

1. All five training groups experienced significant increases in mean performances on the three tests over a seven-week training period.

2. There were no significant differences among the five training groups on any of the pushup tests.

3. The two weight training groups scored significantly better than the alternate day calisthenic groups on the 1RM bench press post-test.

4. There were no significant differences between the daily and alternate day calisthenic groups on the three tests.

5. There were no significant differences between the daily weight training and alternate day weight training group on the three tests.

6. Pushup and bench press performance had a low positive correlation, r=.378, but there was no correlation between improvement in pushup performance and improvement in bench press performance.

Conclusion

Within the limits of this investigation, it can be concluded that the current prescribed physical training program in Initial Entry Training has similar effects on the development of upper body strength and muscular endurance as the current program done with supplemental programs of calisthenics or weight training done daily or on alternate days.

Recommendations for Further Study

A limitation in this study was the scope of the study which was limited to United States Army male recruits. A similar investigation that tests a sample of all Army personnel might also be of interest to the Army.

A further limitation in this study was the duration of the training period which was seven weeks, the length of Initial Entry Training. An investigation of a similar program done during the period following Initial Entry Training would be interesting to see if trends identified by this study continued for a longer period of time.

More extensive calisthenic and weight training programs used in a similar investigation might be able to determine if there is an upper limit to the amount of upper body conditioning that should be done in Initial Entry Training in an effort to determine if too frequent exercise has a detrimental effect on performance.

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APPENDIX A

PILOT STUDY:

RELATIVE FORCE EXERTED IN THE PUSHUP EXERCISE

TABLE 14. Relative force exerted in the pushup exercise.

Subject Number	Subject Weight	Force Exerted in Down Position	% of Weight	Maximum Force Exerted	% of Weight
	(lbs)	(lbs)		(lbs)	
1	200	145	72	168	84
2	186	105	67	121	77
3	196	140	72	170	87
4	160	102	63	140	89
5	146	105	72	127	86
6	165	100	60	141	85
7	160	105	65	133	83
8	160	104	64	142	88
9	171	96	56	125	73
10	195	126	65	160	82
11	210	130	61	172	82
12	234	135	65	174	85
13	145	95	65	115	79
14	168	105	62	130	77
15	172	112	65	146	85
16	119	85	71	101	84
17	212	146	69	172	81
18	192	132	68	164	85
19	157	99	63	132	84
20	178	104	58	130	73
Means	176.3	113.6	65.0	143.2	82.4

APPENDIX B

PILOT STUDY:

BENCH PRESS REPETITIONS USING 75 PERCENT OF 1RM WEIGHT

TABLE 15. Bench press repetitions using 75 percent of 1RM weight.

Subject Number	1RM Weight Lifted	Number of Repetitions
	(lbs)	
1	180	9
2	190	8
3	215	10
4	175	12
5	225	6
6	230	6
7	205	7
8	210	11
9	185	15
10	180	8
Means	199.5	9.2

APPENDIX C

ARMY PHYSICAL TRAINING PROGRAM FOR INITIAL ENTRY TRAINING

Army Physical Training Program for Initial Entry Training

The United States Army's Physical Training Program for Initial Entry Soldiers is divided into 37 one-hour periods of instruction which consist of: a) calisthenic exercises called conditioning drills, b) a two-minute period of situps and a two-minute period of pushups, and c) a platoon run of from one to five miles done at an eight- to ten-minute per mile pace.

Calisthenics. The Army's calisthenic program consists of three conditioning drills of six or seven exercises each. The exercises adopted in 1945 were designed to exercise all the major muscle groups of the body. A one-hour exercise period would contain two of the three conditioning drills. The exercises in each conditioning drill are as follows:

Drill One	Drill Two	Drill Three
High Jumper	Lunger	Side Straddle Hop
Bend & Reach	Turn & Bounce	Back Bender
Pushup	Pushup	Pushup
Trunk Twister	Turn & Bend	Squat Thrust
Squat Bender	Squat Stretch	Side Bender
Body Twist	Stationary Run	Bottoms Up
		Stationary Run

Test Events. Each physical training period has a practice pushup and situp test. The pushup and situp constitute two of the three events on the final physical fitness test. This phase is conducted by having the soldier do all the pushups he can in a two-minute period, then having him do all the situps he can in a two-minute period.

Running. The last half of every physical training period is a platoon run. This run, done in cadence by each platoon (45 to 55 soldiers), varies from one mile to five miles at an eight- to ten-minute per mile pace. The average distance run is 2.5 to 3 miles. The breakdown is as follows:

Distance Run	Repetitions of the Run in Every Seven-Week Cycle
1-2 miles	10
2-3 miles	15
3-4 miles	5
4-5 miles	4


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